SCIENCE STANDARD 12

All students will develop an understanding of the environment as a system of interdependent components affected by human activity and natural phenomena.

INTRODUCTION

This standard brings to New Jersey classrooms the intent of the monumental Tbilisi Declaration, findings adopted in 1977 at the world's first intergovernmental, international conference on environmental education. Specifically, this declaration speaks to "utilizing science and technology . . . to prepare the individual for life through an understanding of the major problems of the contemporary world, and the provision of skills and attributes needed to play a productive role towards improving life and protecting the environment."

In addition, such education should "recognize the complexity and interrelated nature of environmental problems and their possible solutions, and should recognize human dependence on, and responsibility for, a healthy environment."

Finally, such education should recognize the complex relationships that exist between the natural and constructed world.

This standard explores the busy crossroads where content in many science standards intersect and interact. Citizens of all ages often forget that they are a part of, and not separate from, a dynamic and shared environment. People forget that daily activities and the maintenance of a specific quality of life can potentially alter environmental balances. We often forget the relationships that exist between people and human health, other living creatures, and these surroundings. This standard affords students the unique opportunity to understand their place in this world—as living creatures, consumers, decision makers, problem solvers, managers, and planners.

DEVELOPMENTAL OVERVIEW

In grades K-4, curious young children are often intrigued by the simple sprouting of an acorn, the coloration of a songbird, the power of moving water, or the decomposition of a rotting log. Interactive and lively examination of the natural world provides "windows" for young students to observe the interdependent relationships and processes that exist between living creatures and the natural resources.

Primary students then learn to recognize their own basic needs for survival and how those needs are met. They can compare their needs with the basic requirements of other living things. They come to

recognize human dependence on the natural world. Finally, the students learn to distinguish those resources that can be replenished during their lifetime vs. those that require great quantities of time and a unique set of circumstances in order to be re-created.

By grades 5-8, the middle school years, students are getting to know themselves and their own feelings. They recognize their own potential impact on the environment and its resources, based upon close examination of their personal interests, activities, and preferences. In comparing their own findings with similar feedback collected from their peers, other geographic regions, various societies, or different eras, students will recognize that people have different views toward environmental issues. They learn how to evaluate potential environmental impacts.

Finally, middle school students will examine the components of local and global ecosystems and the effects of those components on the organisms that are dependent upon them.

By grades 9-12, as a result of understanding ecosystems and the needs of people and other living creatures, students can act as managers and planners. They investigate the impact of natural phenomena and physical processes, such as earthquakes, fires, and floods, on the environment of New Jersey and different regions in this country and around the world. They will also be able to apply their understanding of ecosystems to solve other types of environmental problems.

Finally, they will use scientific, economic, and health data to assess the environmental risks and benefits that are associated with various types of human activity. At this age, they should research or be presented with well-rounded simulations, projects, experiments, and debates—those that encourage sound decision making and reflect the results of good vs. poor choices, research, plans, or solutions. Students in these grades will be afforded the valuable opportunity of planning or taking responsible action in real-life situations where they can make a recognizable difference.

DESCRIPTIVE STATEMENT

Creating an awareness of the need to protect and preserve natural resources is a goal of science education. This standard calls for students to develop knowledge of environmental issues, including management of natural resources, production and use of energy, waste management, and the interdependence of ecosystems.

CUMULATIVE PROGRESS INDICATORS

By the end of Grade 4, students

1. Investigate the interdependence of living things and their environment.
2. Explain how meeting human requirements affects the environment.
3. Recognize that natural resources are not always renewable.

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 8, students

4. Evaluate the impact of personal and societal activities on the local and global environment.
5. Compare and contrast practices that affect the use and management of natural resources.
6. Recognize that individuals and groups may have differing points of view on environmental issues.
7. Analyze the components of various ecosystems and the effects of those components on organisms.

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students

8. Investigate the impact of natural phenomena and physical processes, such as earthquakes, volcanoes, forest fires, floods, and hurricanes, on the environment of different regions of the United States and the world.
9. Use scientific, economic, and other data to assess environmental risks and benefits associated with human activity.
10. Apply the concept of ecosystems to understand and solve problems regarding environmental issues.

LIST OF LEARNING ACTIVITIES FOR STANDARD 12

GRADES K-4

Indicator 1:

GRADES K-2
Indoor vs. Outdoor Environments
The Four Natural Resources
An Animal and Its Environment

GRADES 3-4
The Web of Life
Interactions in a Habitat
Observing a Tree

Indicator 2:

GRADES K-2
Wastewater
Environmental Themes in Literature

GRADES 3-4
Tree Products
Renewable vs. Nonrenewable Resources
Nonpoint Source Pollution

GRADES K-4
Pizza Makings
Paper Recycling

Indicator 3:

GRADES K-2
Nonrenewable Things
What Grows?

GRADES 3-4
Making Things
Consuming Nonrenewable Resources
Water Cycle
Freshwater

GRADES 5-8

Indicator 4:

GRADES 5-6
Signs of a Healthy Environment
Providing Basic Needs
Transportation and the Environment

GRADES 7-8
Decision Making
Waters of the World
Consumers and the Environment

Indicator 5:

GRADES 5-6
Water Use in the Community
Technology and Culture

GRADES 7-8
Community Planning
Park Visitors
Point Source and Nonpoint Source Pollution

Indicator 6:

GRADES 5-6
Smoking Prevention Advertisement
Advertisements and Wildlife

GRADES 7-8
Points of View
Wildlife Use

GRADES 5-8
Environmental Issues
Class Display Wall

Indicator 7:

GRADES 5-6
Ecosystems of New Jersey

GRADES 5-8
Migratory Shore Birds

GRADES 7-8
Healthy Ecosystem
River Pollutants
Comparing Ecosystems

GRADES 9-12

Indicator 8:

Natural Phenomena
Natural Phenomena in New Jersey

Indicator 9:

Risks and Benefits
Human Health
Identifying Risks

Indicator 10:

Management of Environmental Issues

Indicator 1: Investigate the interdependence of living things and their environment.

LEARNING ACTIVITIES: Grades K-2

Indoor vs. Outdoor Environments. Take the students on a sensory walk of an indoor environment, such as the library or multipurpose room. Ask them if and where they can see, hear, or touch signs of animals, plants, the sun, rocks, soil, air, and water. Take notes on a clipboard.

Walk out to the playground, sit in a circle, observe the surroundings, and repeat the questions. Take notes again. Discuss the similarities and differences between both settings. Discuss how plants and animals use the four elements (air, soil/rock, water, sunlight) and then compare these uses with how people use them. Using a simple chart or diagram, the students compare and contrast their findings from both visits.

Related Science Standard: 6
Related Workplace Readiness Standard: 3

The Four Natural Resources. Students cut out pictures of living things, such as flowers, trees, fungi, and other plants; birds, people, insects, and other animals. They glue each picture to paper or cardboard and make a yarn necklace.

Prior to class, make a necklace for each of the four elements (sun, water, air, soil/rock). Ask four students to each wear one of the necklaces and sit in the center of the classroom. Direct the other students to sit in a circle around the elements. Ask the students, "What things need the sun?" Verify each response and establish connections by instructing students to tautly hold the ends of long "connecting strips" of pre-cut yarn. (Alternately, the students can use a ball of yarn to make the connections.)

When everyone is connected, the element "Water" drops his/her ends. The class will quickly discover what is affected when water quality becomes impaired.

Supporting Educational Research: "Web of Life" in Project *Learning Tree*, pp. 148-50.
Related Science Standard: 6
Related Workplace Readiness Standard: 3

An Animal and Its Environment. Select an animal that is readily seen around the school or in the nearby communities. Create a simple chart where students will, in an ongoing fashion, record their observations of the animal. Categories could include the following:

- food collecting
- shelter needs
- means of travel
- protection measures
- time of day/night most active

After a period of time, discuss how the animal uses its environment to survive and what it contributes to allowing other plants or animals to survive (e.g., a squirrel disperses acorns when it stores them).

Supporting Educational Research: "Squirrel Signs" in Bridges to the Natural World, p. 102.
Related Science Standards: 1, 6, 7
Related Workplace Readiness Standards: 3.1-3.3, 3.7

LEARNING ACTIVITIES: Grades 3-4

The Web of Life. Students brainstorm a list of living, nonliving, and "dead" things that make up an ecosystem or natural area. (For example, woodlands contain dead leaves and logs, grass, rock, etc.) The students then separate these things into three categories: PLANTS, ANIMALS, and OTHER.

Discuss with the students what plants and animals require in order to survive and compare these needs with the things listed in the OTHER category. Make individual labels for all of these things. Mount these labels on the wall in a circle and, using yarn and tacks, work with the students to "link" together all of the interconnections (e.g., sun and grass, water and frog, hawk and mouse).

Alternately, the students form a circle. Hang one label around each student's neck, and instruct the students to pass around a ball of yarn to link themselves together, based upon how the things interact. This process continues until everything is linked. As the students sit quietly, the originating student should begin tugging lightly at the yarn. Anyone who feels the tug should respond with a tug. Ultimately, everyone should feel the tug, demonstrating the interdependence of living and nonliving things in an environment.

Supporting Educational Research: "Web of Life" in *Project Learning Tree*, pp. 148-50.
Related Science Standards: 1, 6, 7
Related Workplace Readiness Standards: 3.1, 3.2, 3.6, 3.7

Interactions in a Habitat. Provide students with pictures of various habitats (or take a series of comparative trips to such areas). Students imagine (or observe) what creatures live in those habitats. On paper, they list the following:

- two physical factors of the area
- two plants
- two animals
- a plant or animal adaptation (e.g., many animals eat the same food but gather it in different ways; plants disperse seeds in different ways)

Next, the students document the types of interactions that they imagine (or observe) taking place in this habitat, including examples of the following types of interactions:

- biological factor on a physical factor (e.g., an animal digging a hole)
- physical factor on a biological factor (e.g., altitude on tree height)
- plant on plant (e.g., a vine growing on a tree)
- animal on plant (e.g., an animal eating a plant)
- plant on animal (e.g., flowers attracting insects)
- animal on animal (e.g., an animal eating another animal)

Afterwards, the students compare findings regarding their habitats.

Supporting Educational Research: "The Eco-Connection" in Bridges to the Natural World, p. 70.
Related Science Standards: 1, 2, 6, 7
Related Workplace Readiness Standard: 3

Observing a Tree. Students adopt one or more local trees for long-term observation. Begin by brainstorming with the class what plants and animals might depend upon that tree. The students visit the tree(s) frequently and look for signs of interdependence, noting all observations and seasonal changes. They work in teams with hand lenses, identification guides or pictures, binoculars, etc. Students document feedback through drawings or descriptions.

Supporting Educational Research: "Trees As Habitats" in *Project Learning Tree*, p. 70.
Related Science Standards: 1-3, 6, 7
Related Workplace Readiness Standard: 3

Indicator 2: Explain how meeting human requirements affects the environment.

LEARNING ACTIVITIES: Grades K-2

Wastewater. Students identify substances and activities within their individual households that can affect water quality, reflecting upon the waste that is usually disposed of down the sink or toilet. Create "sample waste" in the classroom by putting water into a bucket and adding diverse materials such as

- shampoo
- toilet paper
- salad dressing
- gravy (with fat)
- food dye
- detergent
- toothpaste

Mix this up and distribute small paper cups of the mixture to each student. Discuss what *wastewater* is and where it travels to after leaving a home.

Through research, a guest speaker, and/or a video, students learn how wastewater is dealt with in their community. Challenge them to create a simple design of water flow and distribution, including local waterways, filtration plants, and wastewater treatment facilities. Discuss the basic design of a well or septic system, especially if your students or community relies on these. Ask students to design a means to control sink waste at home.

Supporting Educational Research: "My World, My Water and Me."
Related Science Standards: 2, 4, 6, 8
Related Workplace Readiness Standards: 3.2, 3.6, 3.7, 5.1

Environmental Themes in Literature. Use children's literature to discuss cause-and-effect relationships between the activities of people and the effects (positive and negative) on the environment and/or natural resources. Ask students to identify the various issues described in the stories, and challenge them to create and design alternative solutions. Sample stories include the following:

- *The Wump World* by Bill Peet
- *The Lorax* by Dr. Seuss
- *The Giving Tree* by Shel Silverstein
- *The Kapok Tree* by Lynne Cherry
- *Brother Eagle, Sister Sky* by Susan Jefferies

Supporting Educational Research: *Grade One, Day One Curriculum* (Environmental and Occupational Health Sciences Institute).
Related Science Standards: 1, 3, 6, 7
Related Workplace Readiness Standard: 3.8

LEARNING ACTIVITIES: Grades K-4

Pizza Makings. Create a "pizza with everything on it" in the classroom by using an old bedsheet and other materials to represent various toppings. Beginning with the crust, the students trace each ingredient back to the four basic elements (sun, water, soil/rock, air) before each ingredient is layered onto the pizza.

Afterwards, discuss what people need in order to survive. Focusing on food and water, challenge the students to think of food items or drinks that do not require any of the four elements for their existence.

Older students can select one food item and research how its production, packaging, transportation, distribution, consumption, and waste—the many interactions that it has on the environment.

Paper Recycling. Students collect, save, and weigh the class's discarded paper, for one week. Discuss or design ways in which this weight/volume could be reduced, and challenge the students to adopt these new practices in the classroom.

For a second week, the students again collect, save, and weigh the class's discarded paper. Discuss any changes, if any, that took place.

As extension activities, students research the production of new paper and the production of recycled paper. Then they make recycled paper in the classroom.

Supporting Educational Research: *Project Learning Tree*
Ranger Rick's *Nature Scope* Series (National Wildlife Federation).
Grade One Curriculum (Environmental and Occupational Health Sciences Institute).
Related Science Standards: 1-4
Related Workplace Readiness Standards: 3.3, 3.5, 3.7

LEARNING ACTIVITIES: Grades 3-4

Tree Products. The students brainstorm the many products that are made of wood or are otherwise derived from trees. Challenge them to research the topic and then bring in as many of these products as possible. In the classroom, the students label each product as follows:

- #1, if it was produced from tree sap, gum, or resin (e.g., glues, maple syrup, soaps, rubber)
- #2, if it is made of wood (e.g., pencil, toothpick, chair)
- #3, if it is a fruit or nut (e.g., apples, walnuts, cider)
- #4, if it is an extract from the leaves (e.g., tea, lotion)

Review the diversity of products that are derived from trees. As an extension activity, students can do additional research on current conservation and management practices for specific tree species, or historic or cultural uses of trees.

Supporting Educational Research: "We All Need Trees" in *Project Learning Tree*, pp. 39-42.
Related Science Standards: 1, 3, 4, 7
Related Workplace Readiness Standards: 3.2, 3.7, 3.9

Renewable vs. Nonrenewable Resources. Students create a master list of what they think they need to live comfortably. The class discusses the list, labeling each item as

- "Essential for Current Lifestyle"
- "Maintains Current Lifestyle"
- "Luxury"

Through discussion or research, the students trace several key items back to the natural resources from which they were made. For example, a lead pencil requires graphite, wood, metals (paint), rubber (eraser). Discuss the terms *renewable* and *nonrenewable* and provide examples of each type of natural resource. Ask students to identify which items on the master list require renewable resources (label as "R"), nonrenewable resources ("N"), or both ("B") in order to be made or produced.

As an extension activity, students conduct the same activity as Native Americans, Colonial Americans, or Americans in the earlier part of this century.

Supporting Educational Research: "A Look At Lifestyles" in *Project Learning Tree*, p. 354.
Related Science Standards: 1, 3, 6, 8, 9
Related Workplace Readiness Standards: 3.3, 3.5, 3.9

Nonpoint Source Pollution. Students learn that *nonpoint source pollution* occurs when materials such as fertilizers, used motor oil, pesticides, sediments, road salts, and litter enter a local waterway, primarily through rain and runoff. This type of pollution results from human activities.

Each student writes a short story or scenario about one of the pollutants listed above. Place a string on the floor. Students volunteer to stand next to the string, holding an index card. Each volunteer holds a small paper cup with a different color of water in it (Kool-Aid®). Cut the narrow top off an empty plastic milk jug and partially fill it with clear water. Simulating a local waterway/watershed, walk along the string with the jug. Each student reads his/her card and then dumps the contents of the cup into the jug.

Afterwards, discuss potential impacts of nonpoint source pollution, ways that nature can sometimes reduce or break down the amount of pollutants in water, and ways in which people can prevent water pollution. Offer students a drink of the colored water in the jug if Kool-Aid was used. (*Do not drink* the water if food coloring was used!)

Supporting Educational Research: *Project WET.*
Related Science Standards: 1-3, 8, 9
Related Workplace Readiness Standards: 3.3, 3.6, 3.9

Indicator 3: Recognize that natural resources are not always renewable.

LEARNING ACTIVITIES: Grades K-2

Nonrenewable Things. Give each student a piece of bread or cookie. After it's chewed and swallowed, ask the students to make the food item whole again. Discuss why this is not possible. Some materials can be created during the lifetime of an average person, while other items cannot be recreated due to length of time, specific processes, and other factors.

Related Science Standards: 1-3, 8
Related Workplace Readiness Standards: 3.3, 3.6, 3.7

What Grows? Discuss how a seed is a part of a plant and a bottle cap is part of a soda bottle. In a controlled experiment, students plant both of these items and provide them with necessary sunlight and water. After the seed germinates, the students discuss why the seed became a new sprout but why the bottle top did not become a new bottle.

Related Science Standards: 1, 2, 6, 7
Related Workplace Readiness Standards: 3.3, 3.7

LEARNING ACTIVITIES: Grades 3-4

Making Things. Students select a favorite object (e.g., a tennis racket, pair of jeans, a stuffed animal). They list all of the materials that make up the object. Discuss whether the materials are man-made or from the Earth. Explain that all of the materials require natural resources in order to be created. For each of the components making up the favorite object, trace the material back to the Earth's natural resources. Identify each of these resources and discuss with the students which can be replaced or recycled during their lifetime, and which cannot. Discuss the meanings of the terms *renewable* and *nonrenewable*.

As an extension activity, the students research which natural resources are used to produce their community's power/energy.

Supporting Educational Research: "A Few of My Favorite Things" in *Project Learning Tree*, p. 48.
Healthy Environment, Healthy Me, p. 36.
Related Science Standards: 1, 6, 7, 8
Related Workplace Readiness Standards: 3.3, 3.7-3.9

Consuming Nonrenewable Resources. After the class completes the "Making Things" activity, fill a large container with popcorn. Prepare slips of paper (one per student) marked "First Generation," "Second Generation," or "Third Generation." For every group of seven students, there should be one "First Generation" slip, two "Second Generation" slips, and four "Third Generation" slips.

Put the slips into a hat. Each student takes a slip of paper and a small, empty paper bag. Explain that the popcorn represents the world's supply of nonrenewable resources (list some examples). The "First Generation" students place two ample handfuls of popcorn into their bags while the other students watch. Repeat this for the "Second Generation" students and then for the "Third Generation" students. Discuss what happened by the third generation and what would be left for the next (fourth) generation. Discuss the management and long-term considerations of the Earth's nonrenewable natural resources.

Supporting Educational Research: "Renewable or Not?"
in *Project Learning Tree*, pp. 43-46.
Related Science Standards: 1-3, 5, 6, 8
Related Workplace Readiness Standards: 3.7, 3.9, 3.10, 4.2, 4.3, 4.7

Water Cycle. In this activity, students list the components of the water cycle (e.g., lake, ocean, stream, groundwater) as well as ways in which water moves (e.g., precipitation, condensation, evaporation). The students draw a mural of the water cycle and/or act it out. Discuss the role of the sun and the age of water, and how water (a renewable resource) is "recycled/reused," since the Earth is a closed system.

As an extension activity, students research how water is used at home or by various industries. Challenge them to design ways to conserve water at home or at school.

Supporting Educational Research: "The Hydrologic Cycle" in *Grade Four Curriculum*, p. 36 (Environmental and Occupational Health Sciences Institute).
Related Science Standards: 1, 2, 10
Related Workplace Readiness Standards: 3.2, 3.5, 3.8

Freshwater. Although water is renewable, freshwater is limited, and conservation and management are important. Show students a liter of water, and tell them that this amount represents all of the water on the Earth. Pour 30 ml of this water into a 100-ml graduated cylinder, explaining that this amount represents freshwater (about 3% of the total). Pour salt into the remaining 97% to represent the saltwater found in the oceans.

Going back to the cylinder, explain that almost 80% of the Earth's freshwater is frozen in ice caps and glaciers. Pour 6 ml of the freshwater into a dish, and place the cylinder and remaining water into a freezer (or closet). Going back to the water in the dish, only 1.5 ml of this is surface water while the rest is groundwater. Use an eyedropper to remove a single drop of fresh, surface water. This amount represents the percentage of fresh water available for use and consumption by living things.

Supporting Educational Research: "A Drop in the Bucket" in *Project WET*, p. 158.
Related Science Standards: 1-3, 5
Related Workplace Readiness Standards: 3.7-3.9

Indicator 4: Evaluate the impact of personal and societal activities on the local and global environment.

LEARNING ACTIVITIES: Grades 5-6

Signs of a Healthy Environment. In this activity, students recognize critical "indicators" of a healthy environment. First, discuss indicators such as the following:

- clean air and water
- fertile soil
- abundance and diversity of indigenous plants and animals
- reproduction of life forms
- evidence of the recycling of nutrients

The class splits into field teams. Each team carries out an experiment or exercise in a local outdoor setting where one or more of the above environmental factors are present. Each activity is designed to reveal something about the relative health of the local environment, as suggested by the condition of that factor. For example, soil tests indicating favorable soil nutrients suggest that healthy populations of plants and animals probably live off of that soil. Students can then verify the actual presence of these plants and animals.

Afterwards, students discuss the impact (positive or negative) that one or more personal and societal activities may have on the various environmental factors studied in this activity.

Related Science Standards: 1, 2, 7
Related Workplace Readiness Standard: 2

Providing Basic Needs. Students first discuss the basic needs of humans (e.g., water, air, shelter, food, open space). Obtain a piece of rope long enough to form a circle for the entire group to step into and stand comfortably, then place the rope on the ground. Ask the students to step inside the circle, then instruct them to step outside the circle. Explain to the group that part of their environment has been impacted due to development. Reduce the size of the rope, and ask the group to again enter the space provided inside the circle. Decrease the size of the circle using various issues that pertain to the loss of habitat or of a basic need (e.g., water pollution, roadways, litter).

Ask the group to explain what happened as they lost a portion of area or of that resource. Discuss how both plant and animal species in this area might adapt and deal with the changing situation. What are their options? Challenge the group to identify potential solutions that would prevent such losses, or have them bring in newspaper articles that represent this occurrence.

Related Science Standards: 1, 2, 6
Related Workplace Readiness Standard: 2

Transportation and the Environment. In this activity, students explore driving and transportation options. Small groups of students walk to busy intersections near the school where they can safely observe traffic. For about 30 minutes, they count the number of cars that pass by in one direction, and record the number of persons in the car.

Back in the classroom, the students calculate whether air pollution would increase or decrease if people traveled by bus instead of car. They use the following estimates:

- One bus carries 50 persons.
- One bus causes the same amount of air pollution as five cars.

The students discuss why bus transportation might not be favored. They plan and conduct a survey of driving patterns in their school or surrounding community. As an extension activity, they research public transportation patterns in other areas, and design a school or community transportation plan.

Supporting Educational Research: Adapted from "Car Count" in *Healthy Environment, Healthy Me—Exploring Environmental Issues*, p. 52 (Environmental and Occupational Health Sciences Institute).
Related Science Standards: 1-5
Related Workplace Readiness Standards: 2-5

LEARNING ACTIVITIES: Grades 7-8

Decision Making. In this simulation activity, students role-play various interest groups who make decisions based on the facts presented.

> *Sample Situation:* A person who owns a lot in a shopping district wants to put a car business on the lot. The city requires that the lot conforms to city codes and guidelines. Neighbors do not want noise and visual pollution. Environmental groups want to protect the existing natural features.

Create a list of needed requirements for a proposal. The class then divides into groups, each of which develops a proposal that addresses the concerns of all parties. Each group presents their proposal to another group of students representing the City Council. The City Council makes the final decision and presents their rationale.

Supporting Educational Research: Democracy In Action" in *Project Learning Tree*, pp. 196-200.
Related Science Standards: 1-4
Related Workplace Readiness Standards: 2-4

Waters of the World. In this activity, students imagine water flowing from their location to all parts of the world and prepare a narrative. They identify specific water cycle components, such as oceans, rivers, and the atmosphere, and emphasize the interrelatedness of the world's waters.

Next, the students take a field trip to a local waterway and measure the flow rate of a local stream, canal, or river (or research this information). They compare their results to the amount taken local-

ly from the same source by the community water utility. Discuss with the students how the water is used and how it is returned to the environment. Emphasize that this movement occurs over and over again. For example, water utilities take 75 million gallons of water from the Delaware and Raritan Canal each day, providing approximately 140 gallons per day per person to the area served. The canal is 6 feet deep and 42 feet wide. The students calculate the flow (in gallons per day) by identifying the length of the section and the time it takes for a drop of water to flow through that section.

Supporting Educational Research: "Water Wings" in Aquatic *Project Wild*, p. 4.
Related Science Standards: 2, 3, 5, 10
Related Workplace Readiness Standards: 2-5

Consumers and the Environment. Divide the class into smaller groups with the following assignment: to plan a party for 20 middle school students with a budget of only $50.00. You need to choose a location for the party and figure ways to obtain enough food, drinks, plates, utensils, party decorations, music and any other necessary supplies for $50.00 or less. In addition, all decisions must take into account its impact(s) on the environment. Each group will present their purchases to the class. Allow time for research and price gathering.

Supporting Educational Research: "Talkin' Trash, An Earth Saver Activity" in *Environmental Decision Making for Middle School Students* (Environmental and Occupational Health Sciences Institute).
Related Science Standards: 2, 5
Related Workplace Readiness Standards: 2-4

Indicator 5: Compare and contrast practices that affect the use and management of natural resources.

LEARNING ACTIVITIES: Grades 5-6

Water Use in the Community. Through a simulation activity and research, students analyze water use and management. First, students use the yellow pages of a phone book to identify various ways that water is used in their community.

Afterwards, the class goes outdoors with a large bucket, water, and various sizes of sponges. Through an organized relay race, students simulate a growing population and the various volumes of water needed by homes, schools, industries, restaurants, etc. Water being returned to the bucket represents movement in the water cycle. Students can use food coloring to mark "sediments" from runoff or "leakage" from a pipe or storage container. Students can research the amount of water actually used in a growing community and then make realistic calculations about water use.

Supporting Educational Research: "Common Water" in *Project WET*, p. 232.
Related Science Standards: 2, 3, 5
Related Workplace Readiness Standards: 2-5

Technology and Culture. Students research and compare the technologies of three different cultures in United States history to determine their relative impacts on the environment:

- Lenni-Lenape (circa 1000)
- Colonial America (circa 1800)
- New Jersey (1990s)

Students review the impacts of technologies related to shelter construction, food gathering and preparation, and heat and warmth. They compare the technologies in terms of the following:

- resources used
- energy consumed
- pollution created
- significant alterations to the land

As an extension activity, students review contemporary technologies and suggest alternatives that might be more environmentally "friendly" than existing ones.

Related Science Standards: 2-4
Related Workplace Readiness Standards: 2, 3

LEARNING ACTIVITIES: Grades 7-8

Community Planning. In this activity, small groups of students work together to lay out and develop a working community around a body of water. First, draw a picture of a lake (with incoming and outgoing streams), and give one copy to each group of students. Somewhere on their paper the students draw the following:

- a strip mall (containing a theater, food mart, dry cleaners, restaurant)
- a parking lot
- a gas station
- an apartment building
- a housing development
- a school
- a protected wetlands area
- a bleach factory
- a print shop
- a farm feed lot
- a corn field
- a fire house
- offices
- roads where needed

The class compares and discusses the communities. Attach the incoming and outgoing streams together, and ask the students if they would make any changes, knowing that their decisions can impact other communities.

Supporting Educational Research: "Dragonfly Pond" in *Project Aquatic WILD*, pp. 154-59.
Related Science Standards: 2, 3, 5, 6
Related Workplace Readiness Standards: 2, 3

Park Visitors. Students share their experiences with any national parks that they have visited. Using their combined experiences, they design a national park on the chalkboard, describing its natural features, topography and acreage, as well as recreational needs and uses of the property. Discuss why parks are usually created and why they are so popular. Ask students to identify typical park expenditures and potential sources of incoming funds.

Visits to national parks have increased during the last 50 years, presenting parks with many issues. The class divides into three groups, and each group selects an issue such as

- traffic, congestion, and not enough parking
- increased illegal activities, such as vandalism, theft, rapes, etc.
- increased demands for high-impact recreation (e.g., off-road vehicles, mountain bikes, snow mobiles)

After researching the issue, the students share their solutions and discuss how parks might pay for additional costs. They discuss park policies regarding research, timber and wildlife management, commercialism, etc., and identify management guidelines for a long-term plan.

Supporting Educational Research:
"Loving It Too Much" in *Project Learning Tree*, pp. 108-113.
Related Science Standards: 1-3, 5, 6
Related Workplace Readiness Standard: 2

Point Source and Nonpoint Source Pollution. To identify the various land uses in their community, students obtain local maps, such as road maps, aerial photographs, and topography maps. (A phone book may be helpful.) They note all surface water bodies and groundwater in their area. Students discuss potential point and nonpoint sources of water pollution that can result from these land uses, including the following:

- erosion
- air emissions
- discharges
- agricultural runoff

The students monitor the water quality of a local waterway by collecting samples and conducting tests on a regular basis. In this way, they document the impact of development and accompanying pollution.

Related Science Standards: 1, 2, 4
Related Workplace Readiness Standards: 2, 3

Indicator 6: Recognize that individuals and groups may have differing points of view on environmental issues.

LEARNING ACTIVITIES: Grades 5-6

Smoking Prevention Advertisement. Students find and share ads for various brands of cigarettes. They discuss the images portrayed by the ads and what attracts young people to smoking. Working in small groups, they create a smoking prevention ad for either radio or the print medium, incorporating at least one fact they learned about smoking (e.g., health effects or secondhand smoke hazards). Afterwards, the groups share their ads with the class.

Students can create similar ads for issues such as littering, water conservation, energy conservation, and waste reduction.

Supporting Educational Research: Adapted from "Enviro-ad for Health" in *Healthy Environment, Healthy Me—Exploring Air Pollution Issues*, p. 78 (Environmental and Occupational Health Sciences Institute).
Related Science Standards: 1-3, 6
Related Workplace Readiness Standard: 3

Advertisements and Wildlife. Students brainstorm and discuss their feelings/impressions about specific wildlife (e.g., an eagle, a wolf, a deer, an owl, a turkey). They discuss slang phrases such as "you sly fox!" and "a wise old owl." Each student brings in or describes one or more advertisements that use a form of wildlife or the natural environment (e.g., a pristine wooded area or a canyon) as part of the ad. The students discuss answers to the following questions:

- What image was used?
- What is the advertiser's purpose?
- Does the wildlife or natural area used have a direct relationship to the product?
- What feelings and/or stereotypes are elicited?
- Is the wildlife or natural area depicted realistically?
- Does this portrayal encourage or discourage increased environmental awareness?

Afterwards, the students create ads that use wildlife and the environment and describe to their classmates the intent of their design.

Supporting Educational Research: Adapted from "Does Wildlife Sell Cigarettes?" in *Project WILD*, pp. 232-33.
Related Science Standards: 1-3, 6
Related Workplace Readiness Standard: 3

LEARNING ACTIVITIES: Grades 5-8

Environmental Issues. Prepare at least five environmental statements that can evoke controversy and can be responded to in varying degrees between "Strongly Agree" and "Strongly Disagree." Examples include the following statements:

- "Humans have a responsibility to protect *all* life-forms on Earth."
- "Individuals should be able to use their own land in whatever way they see fit."

Using chalk, string, or tape, create a scale of 1 to 10 on the floor, with the numbers having at least a yard between them. Designate one end as "Strongly Agree" and the other end as "Strongly Disagree." After each statement is read, ask the students to find a place on the line that describes their opinion on the statement.

When all the students are standing on the line, half of the students (those standing at the left, for example) walk to the other end of the line to face a partner having a different point of view. Ask each student to listen to, and memorize, the opinion of his/her partner. Students then share their partner's opinion with the class and state whether their own feelings changed after listening to the other opinion.

Supporting Educational Research:
Adapted from "Values on the Line" in Project Learning Tree, pp. 58-60.
Related Science Standards: 1-4
Related Workplace Readiness Standards: 2, 3

Class Display Wall. The class creates a display in the classroom that collectively represents each student's perspective on an environmental issue. Items mounted on the wall could include

- quotes
- articles
- drawings
- poetry
- photography
- cartoons

Related Science Standards: 1, 3, 4
Related Workplace Readiness Standard: 2

LEARNING ACTIVITIES: Grades 7-8

Points of View. Individually or in small groups, students select a local or global environmental issue that has various perspectives. They research the various points of view, e.g., environmentalists rallying for the preservation of a wildlife species' habitat vs. others arguing for jobs that would be lost if development does not occur.

The students present these perspectives to the rest of the class and generate recommendations on how to resolve the controversial issue. In a class discussion, the students analyze

- whether these opinions are informed
- whether these opinions are addressed through their recommendations

Related Science Standards: 1-3
Related Workplace Readiness Standards: 2, 3

Wildlife Use. Students brainstorm a list of ways in which wildlife is used. They then volunteer to represent one side or another on the following debate topic: "Wildlife populations should be managed by humans or left to nature." Each team researches and prepares arguments regarding its position and appoints a captain to present opening remarks. The captains then select one member of their team to "face off." First one person, then the other, is given one minute to present his/her point of view. The remaining students in the class judge and award a point to the team with the best argument presented, per pair of students.

After the debate, students summarize their own perspectives on consumptive and nonconsumptive uses of wildlife.

Supporting Educational Research:
Adapted from "Pro and Con: Consumptive and Non- consumptive Uses of Wildlife" in *Project WILD*, p. 250.
Related Science Standards: 1-3, 6
Related Workplace Readiness Standard: 3

Indicator 7: Analyze the components of various ecosystems and the effects of those components on organisms.

LEARNING ACTIVITIES: Grades 5-6

Ecosystems of New Jersey. Students identify at least three types of ecosystems that exist in New Jersey (e.g., fields, woodlands, and freshwater wetlands). For each ecosystem, they brainstorm and list various features of that ecosystem, such as its flora, fauna, seasonal changes, topography, and ground cover.

Each student selects an ecosystem and then "invents" an imaginary animal to live there, identifying its sex and describing its adaptations to the environment, including its

- food source(s)
- shelter
- behavioral patterns
- protection against enemies
- means of travel

The students draw a picture of their creature. In a presentation to their classmates, the students describe their creature as well as its surroundings and adaptations.

Supporting Educational Research: Adapted from "Adaptation Artistry" in *Project WILD*, pp. 114-15.
Related Science Standards: 1, 2, 6, 7
Related Workplace Readiness Standards: 3, 4

LEARNING ACTIVITIES: Grades 5-8

Migratory Shore Birds. Students research a species of migratory shorebird, songbird, or raptor, focusing on its travel between nesting habitats and wintering grounds, and the hazards along the way. In their report, they should do the following:

- List the limiting factors affecting populations of their bird species.
- Predict the effects of such limiting factors.
- Describe the effects of habitat loss and degradation on the population of their bird species.
- Make inferences regarding the importance of a suitable habitat for their migratory bird species.

Supporting Educational Research: Adapted from "Migration Headache" in *Project WILD*, pp. 94-98.
Related Science Standards: 1, 5-7
Related Workplace Readiness Standards: 2-3

LEARNING ACTIVITIES: Grades 7-8

Healthy Ecosystem. After reviewing the conditions necessary for a healthy ecosystem, students describe what could happen to an ecosystem if these conditions are altered or eliminated. They discuss what clues they would look for to determine if an ecosystem is healthy or not. Working in small groups, students select a macroinvertebrate species to research. They prepare a report about their critter and present the report to the class.

After the presentations, the class compares each organism's tolerance of different stream conditions.

Supporting Educational Research: Adapted from "Macro-Invertebrate Mayhem" in *Project WET*, p. 322.
Related Science Standards: 1, 2, 6,
Related Workplace Readiness Standards: 2, 3

River Pollutants. Present the class with a hypothetical river and examples of chemical, thermal, organic, and ecological pollution that might impact it. After researching major sources of these types of pollutants, the students make inferences regarding the potential effects of these pollutants on aquatic plants and animals. They investigate the laws, policies, and practices already in place in New Jersey that help to protect the integrity of aquatic ecosystems. Finally, the students make recommendations regarding actions that can be taken to protect water quality and prevent, reduce, or otherwise control the pollutant that they researched.

Supporting Educational Research: Adapted from "Deadly Waters" in *Project Aquatic WILD*, pp. 146-50.
Related Science Standards: 2, 4, 5
Related Workplace Readiness Standards: 2, 3

Comparing Ecosystems. Students identify the types of ecosystems that exist in New Jersey (e.g., fields, woodlands, and freshwater wetlands). For each ecosystem, they brainstorm and list various features of that ecosystem, such as its flora, fauna, seasonal changes, topography, and ground cover.

Next, each student selects two similar plants (e.g., wildflowers) or animals (e.g., songbirds) that live in two different ecosystems. After researching each species, the students compare and contrast their specific adaptations and discuss how each species meets its basic needs.

Related Science Standards: 1, 2, 6, 7
Related Workplace Readiness Standards: 3, 4

Indicator 8: Investigate the impact of natural phenomena and physical processes, such as earthquakes, volcanoes, forest fires, floods, and hurricanes, on the environment of different regions of the United States and the world.

LEARNING ACTIVITIES: Grades 9-12

Natural Phenomena. Students brainstorm and develop a comprehensive list of natural phenomena. Working in small groups, they select and investigate a specific event. If possible, their research should focus on three different areas where the event occurs—areas that vary according to population, geographic location, and land use. Their findings should comprehensively describe the phenomenon and include the following:

- characteristics and/or causes of the natural phenomena
- warning signals that scientists have developed
- protective measures (if any) that have been taken

Each group presents its findings to the class and identifies any beneficial outcomes of these occurrences. Students discuss why such phenomena are often disastrous to humans, and how such disasters might be prevented or avoided.

Related Science Standards: 2, 9, 10
Related Workplace Readiness Standards: 2, 3

Natural Phenomena in New Jersey. Students investigate natural phenomena that significantly impact New Jersey, such as coastal storms, Passaic River flooding, drought, and forest fires in the Pinelands. They research various sources, including the following:

- historical accounts and impacts
- current regulations
- local ordinances and other preventive measures
- varying opinions of interested parties regarding the phenomena

Afterwards, the students present their findings to the class.

Related Science Standards: 2, 3, 9, 10
Related Workplace Readiness Standards: 2, 3

Indicator 9: Use scientific, economic, and other data to assess environmental risks and benefits associated with human activity.

LEARNING ACTIVITIES: Grades 9-12

Risks and Benefits. Students list and describe their favorite activities that involve a level of personal risk. For each activity, they identify their personal benefits in a column labeled "Benefits." In another column labeled "Risks and Costs," they list all financial costs, environmental impacts, and potential health risks that are related to the activity. Finally, they add other potential environmental, financial, and health benefits to the "Benefits" column.

When the students have each completed these lists for at least four of their favorite activities, they prioritize them according to which they feel have the most benefits and least risks. For example, driving a van with three families from home to the football game may have the benefits and risks/costs outlined below:

Benefits

- vanpooling
- social/fun/recreational
- support provided for team

Risks and Costs

- potential for an accident while in vehicle
- air pollution caused by van
- cost to get into game

Related Science Standards: 2, 4, 5, 8, 9
Related Workplace Readiness Standards: 1-3

Human Health. In small groups or as a class, students generate a list of environmental issues that have potential impacts on human health. Examples include the following:

- outdoor air pollution (ozone or particulate matter)
- indoor air pollution or smoke
- radon
- radiation exposure
- contaminated drinking water
- potentially harmful chemicals in consumer products

- pesticide usage
- oil spills and landfills
- hazardous waste spills
- droughts
- hunting

Each student ranks each issues as *High Risk (H), Medium Risk (M), or Low Risk (L)*. Tally everyone's feedback.

Students select issue and conduct research regarding scientific and economic factors, health and environmental impacts, as well as preventive and control measures that are related to each issue. After they present their reports to the class, they revisit their personal and group rankings.

Supporting Educational Research: Adapted from "What's the Risk?" in *Environmental Science: How The World Works and Your Place In It*, by Jane Person.
Related Science Standards: 1, 2, 8-10
Related Workplace Readiness Standards: 1.3, 1.5

Identifying Risks. Students identify risks that historically had great impacts on human health but have since been resolved. Examples include the following risks:

- water-borne diseases reduced by water purification
- car injuries reduced by seat belts
- bicycle injuries reduced by helmets

Students research the scientific data concerning the problem, how it was reduced, and the resulting benefits.

Related Science Standards: 2-5
Related Workplace Readiness Standards: 1.5, 2.2

Indicator 10: Apply the concept of ecosystems to understand and solve problems regarding environmental issues.

LEARNING ACTIVITIES: Grades 9-12

Management of Environmental Issues. Students research how various environmental issues are being managed in New Jersey using a regional "systemic" approach. Examples of such an approach include the following:

- watershed management
- the Ozone Transport Commission
- the Pinelands
- management of the Delaware Bay, Barnegat Bay, and Great Egg Harbor Estuary Program

Afterwards, the students present their findings to the class.

Related Science Standards: 1, 2, 4
Related Workplace Readiness Standards: 1.3, 1.6, 2.2, 3.4